GERMINATION AND DEVELOPMENTAL MORPHOLOGY OF SEEDS IN UTRICULARIA CORNUTA MICHX. AND UTRICULARIA JUNCEA VAHL[1]

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An investigation of seedling morphology is often helpful in understanding the taxonomy of species but relatively few observations on seedlings of *Utricularia* have been reported (e.g., Goebel, 1891; Kumazawa, 1967). Morphology and physiology of seed germination and seedling growth of certain species of *Utricularia* in axenic cultures have been studied by Pringsheim (1962), Harder (1963), and Swamy and Mohan Ram (1969). All species used in their experiments were free floating or anchored aquatics; none was a terrestrial or epiphytic species. However, studies of the seedlings of terrestrial *Utricularia cornuta* Michx. and *U. juncea* Vahl are here reported for the first time.

Both *Utricularia cornuta* and *U. juncea* occur only in the New World. The former ranges from Texas to Florida, north to eastern Canada along the coast and westward to Upper Great Lakes, while *U. juncea* occurs in the eastern United States, West Indies, British Honduras, Trinidad, Guayana, Brazil, and perhaps Paraguay. In the southeastern United States, however, both taxa occur on the Coastal Plain.

Utricularia cornuta and *U. juncea* have sometimes been placed in the genus *Stomoisia* Raf. (Barnhart, 1913, 1915, 1933). Since both species are closely related, they needed to be examined for possible evidence which would contribute to a satisfactory taxonomic treatment, which stimulated me to make this study.

MATERIALS AND METHODS

Plants of *Utricularia cornuta* and *U. juncea* were col-

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[1]This paper is a minor part of a thesis submitted to the Department of Botany of The University of North Carolina, Chapel Hill, in partial fulfillment of the requirement for the degree of Master of Arts.

Table 1. Field collections and their populations (the following list shows the field collections and their populations made in connection with this study).

Population No.		Collection No.	State & County	Locality
U-12	*U. cornuta*	534-536	North Carolina: Watauga Co.	Long Hope Creek Valley
U-22	*U. cornuta*	764-768	Florida: Nassau Co.	1 mile north of Hwy. U. S. 90, on Hwy. Fla. 121
U-2	*U. juncea*	970	North Carolina Duplin Co.	3.4 miles northwest of junction of Hwy. N. C. 50 & 53, on Hwy. N. C. 50, northwest of Maple Hill
U-3	*U. juncea*	968-969	North Carolina: Pender Co.	on dirt road which turns north of Hwy. N. C. 50, 2.2 miles southeast of Maple Hill
U-7	*U. juncea*		North Carolina: Brunswick Co.	3.3 miles north of junction 17 & 130, near Shallotte, on Hwy. N. C. 130
U-14	*U. juncea*	972	North Carolina: Brunswick Co.	4.1 miles northwest of Shallotte, on Hwy. N. C. 130

lected in North Carolina and Florida, from the populations listed in Table 1, and were brought to the greenhouse and grown under condition of high moisture and light intensity. Both species produced seeds which were used in this study. The following four media were used in the present study.

In the first medium, soil samples from the locality of the U-3 population were used. Two pieces of filter paper were put on soil samples in petri-dishes in which the pH was controlled by different mixtures of 0.2 M HCl and 0.5 M

NaOH. Four different solutions were used: a. pH 7.2; b. pH 4.5; c. pH 4.7; d. pH 5.1. Seeds of *Utricularia juncea* (U-3) were planted on the filter paper and kept in petri-dishes at room temperature (ca. 25°C).

In the second medium, a buffer solution was used. A stock solution was prepared by the following method: 4.88 gm of MES (2 N-Morpholino ethane sulfonic acid) in 250 ml. of distilled water was used to prepare 0.1 M buffer solution. This solution was diluted by adding 9 parts distilled water to 1 part stock solution. The pH of the buffer solution was adjusted with acid (0.2 M HCl) or base (0.5 M NaOH). Seeds of *Utricularia cornuta* and *U. juncea* were planted on filter paper with the buffer solution in the petri-dishes kept at room temperature.

The third medium was a solution of 500 ppm potassium gibberellic acid. Seeds of *Utricularia cornuta* (U-12 and U-22) and *U. juncea* (U-14) were planted on filter paper with this solution in petri-dishes kept at room temperature.

Moore's solution (Koch, 1967, pp. 14-15) was the fourth medium used. The fruits of *Utricularia cornuta* (U-12) and *U. juncea* (U-14) were first washed and sterilized with 100% ethylalcohol. Seeds were scooped from the sterilized fruits and spread in the medium in sterilized flasks.

RESULTS AND DISCUSSIONS

The results are listed on Table 2. The seeds of *Utricularia juncea* planted in a soil sample of pH 7.2, have not germinated. On many kinds of soil samples, however, the seeds have shown a low percentage of germination. Seeds of both species showed higher rate of germination only in Moore's solution.

Seedlings of the two species differ morphologically. Those of *Utricularia juncea* usually have only one chlorophyllose cotyledon and a second cotyledon, or a cotyledon-like structure, which lacks chlorophyll. The second cotyledon grows and develops into a rhizome on which some bladders and trichomes may be formed (Fig. 1-8, and 1-9). This seedling morphology is very similar to that observed by Goebel (1891) in the Asiatic *U. orbiculata* Wall., which was placed

Table 2. Germination data for planting at room temperature (ca. 25°C) of *Utricularia* seeds.

Species	Seed Identification Number	Medium	pH	Germination Percentages	No. of Seeds Used
U. cornuta	U-12-6	Buffer Solution	5.0	3.1	387
	U-22	Buffer Solution	5.0	2.9	724
	U-12-1	Gibberellic Acid	4.5	11.0	740
	U-22	Gibberellic Acid	4.5	10.8	259
	U-12	Moore's Solution	4.5 -5.0	87.4	144
U. juncea	U-3-1	Soil Sample	7.2	0.0	1310
	U-3-1	Soil Sample	4.5	7.0	935
	U-3-1	Soil Sample	4.7	2.5	1225
	U-3-1	Soil Sample	5.1	1.5	1531
	U-2-2	Soil Sample	5.1	1.0	1260
	U-7-1	Buffer Solution	4.5	13.4	156
	U-14	Gibberellic Acid	4.5	8.2	415
	U-14	Moore's Solution	4.5 -5.0	98.3	3650

in *U. striatula* Sm. by Taylor (1964). The most interesting observation was that *U. cornuta* showed two types of seedling morphology, correlated with different media. In buffer or Moore's solutions, the seedlings were similar to those of *U. juncea* in that one green cotyledon and one cotyledon-like structure, which developed into a rhizome, were formed. However, the angle between these structures was quite different from that in seedlings of *U. juncea* growing in buffer or Moore's solution. The other type of *U. cornuta* seedling was the normal two-cotyledon type which developed in gibberellic acid solution (Fig. 1-1 to 1-7). This type of germination is that usually shown in aquatic species of *Utricularia*

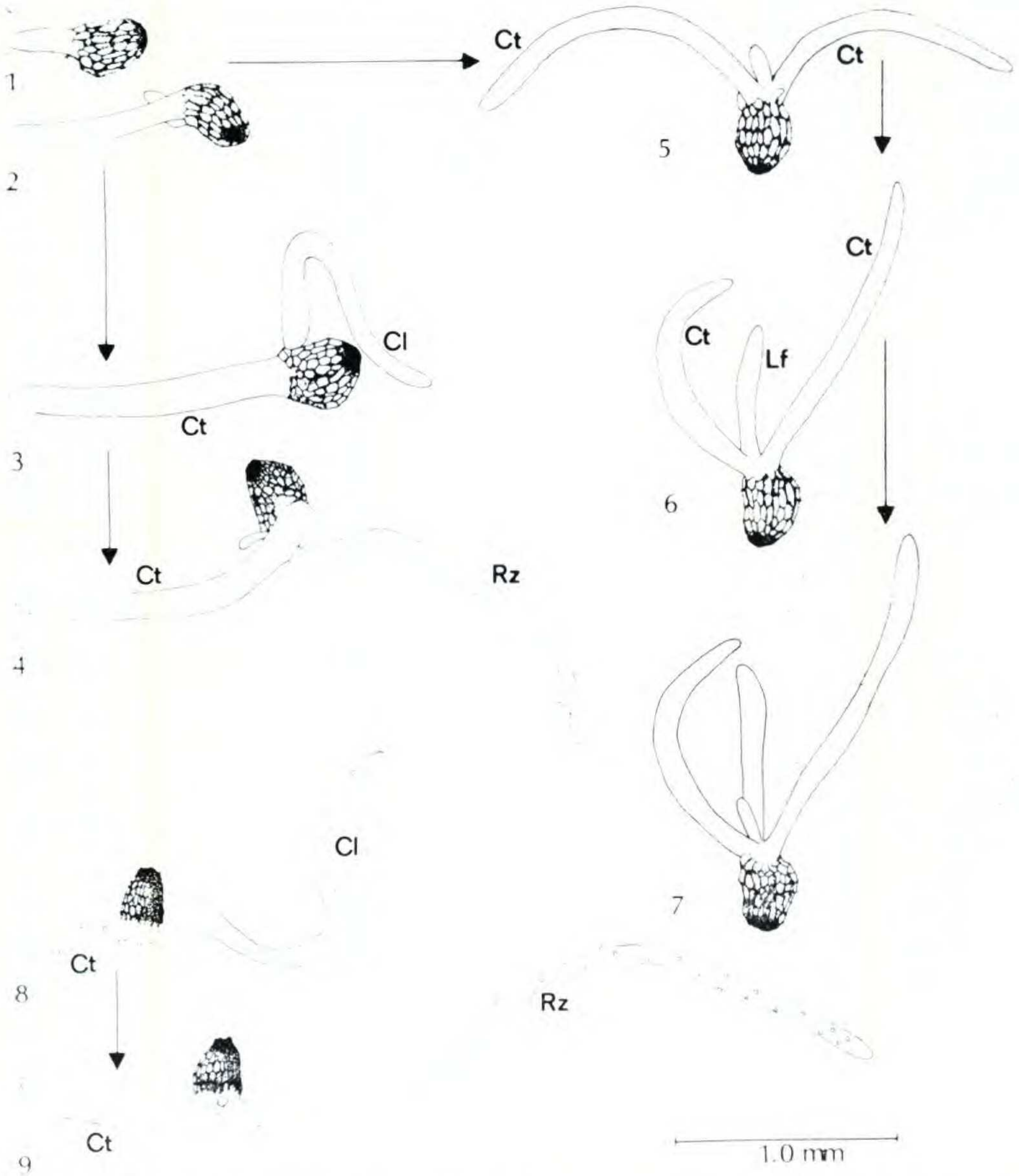

Fig. 1. Seedlings of: — 1-7. *Utricularia cornuta*; — 8-9. *Utricularia juncea*. 1-2. Germination; 3. Seedling with one cotyledon (Ct) with chlorophyll and cotyledon-like structure (Cl) which lacks chlorophyll; 4. Seedling with a cotyledon-like structure developing into the rhizome (Rz); 5. Seedling with two normal cotyledons (Ct); 6. Seedling with two cotyledons (Ct) and the first leaf (Lf); 7. Seedling with two cotyledons, the first leaf, and the second leaf growing; 8-9. Seedling with one cotyledon and a cotyledon-like structure developing into the rhizome with some trichomes.

(e.g., Kumazawa, 1967). Collections of seeds from two geographically diverse populations, U-12 from Watauga Co., North Carolina and U-22 from Nassau Co., Florida, gave the same results. This might be a mechanism for adaptation to some unknown environmental factor to which populations are exposed.

ACKNOWLEDGMENTS

I wish to express sincere appreciation to Dr. C. R. Bell, Department of Botany, The University of North Carolina, who directed my research program and has been especially helpful in many other ways. I am similarly indebted to Dr. A. E. Radford and Dr. C. R. Parks, Department of Botany, The University of North Carolina, for their interest and helpful suggestions during the preparation of this thesis. Appreciation is also expressed to Dr. N. G. Miller, Department of Botany, The University of North Carolina, and Dr. A. J. Sharp, Department of Botany, The University of Tennessee, for their interest in this work and for reading the manuscript.

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